

EUROPEAN PATENT OFFICE

Patent Abstracts of Japan

PUBLICATION NUMBER : 05007109
PUBLICATION DATE : 14-01-93

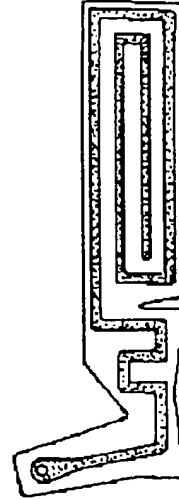
APPLICATION DATE : 27-06-91
APPLICATION NUMBER : 03156847

APPLICANT : MITSUBISHI ELECTRIC CORP;

INVENTOR : KONDO YASUHIRO;

INT.CL. : H01Q 9/42 H01Q 1/24

TITLE : BUILT-IN ANTENNA FOR PORTABLE
TELEPHONE SET



ABSTRACT : PURPOSE: To realize the antenna of a small size and high performance by forming the antenna in a required shape on a flexible board.

CONSTITUTION: An antenna is formed in spiral or in zigzag on a flexible board, and a transmission antenna and a reception antenna are provided separately and mounted in a case of the portable telephone set having a radio transmitter- receiver or the like. Through the constitution above, broad band processing is attained, no matching circuit is required and the antenna built in the portable telephone set with small size, thin profile and high performance of excellent radiation efficiency is realized.

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(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平5-7109

(43) 公開日 平成5年(1993)1月14日

(51) Int.Cl. ⁵	識別記号	庁内整理番号	F I	技術表示箇所
H 0 1 Q	9/42	7046-5 J		
	1/24	Z 7046-5 J		

審査請求 未請求 請求項の数1(全 4 頁)

(21) 出願番号 特願平3-156847

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(22) 出願日 平成3年(1991)6月27日

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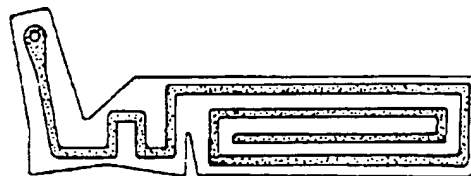
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(54) 【発明の名称】 携帯電話用内蔵アンテナ

(57) 【要約】

【目的】 アンテナをフレキシブルプリント基板上にスパイラル状に形成することによりアンテナの広帯域化を図り、整合回路を不要にし、アンテナコストの低減をはかる。

【構成】 アンテナをフレキシブルプリント基板上に、スパイラル状またはジグザグ状に形成し、送信用アンテナと受信用アンテナを別々に設けて、ケース内に実装される。



【特許請求の範囲】

【請求項1】 (1) 携帯電話機側面付近に幅を持った形状で先端側から終端側に配設し、前記携帯電話機に内蔵したフレキシブルプリント基板と、前記フレキシブルプリント基板上に前記基板形状に沿って幅方向に分布させたスパイラル状もしくはジグザグ状にパターンを形成させたアンテナ導体とを具備した携帯電話用内蔵アンテナ。

(2) アンテナ導体周辺をポリイミドで絶縁した特許請求の範囲第1項記載の携帯電話用内蔵アンテナ。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 この発明は携帯電話用内蔵アンテナに関するものである。

【0002】

【従来の技術】 図4は従来技術の線状アンテナを配設した携帯電話機の構成を示す図である。1は携帯電話機、2はプリント基板、3はプリント基板2上に実装される無線送受信機、4は整合回路、5は送信アンテナ、6は受信アンテナである。無線送受信機3の出力は整合回路4を経由して送信アンテナ5へ入り送信される。また、受信アンテナ6が受信した信号は整合回路4を経由して無線送受信機3へ入る。送受信アンテナ5、6は使用される搬送波（以下キャリアという）の周波数により長さが異なり、一般的には $1/4\lambda$ （ $\lambda=v/f$ v :光速、 f :キャリア周波数）とされている。

【0003】 次に動作について説明する。図4において、プリント基板2には電源部、制御部および音声部などが組み込まれている。プリント基板2からの出力は無線送受信機3内で、搬送波に変調されて整合回路4に入る。整合回路4は送信アンテナ5と無線送受信機3とのインピーダンスマッチングをとるためのものであり、一般的には図8に示すようにインダクタンス a とコンデンサ b により構成される。送信アンテナ5に加えられた搬送波は送信アンテナ5により空間に放射される。基地局側から送信された電波は受信アンテナ6により受信され、整合回路4を介して、無線送受信機3へ効率よく送られる。無線送受信機3は受信した搬送波を復調してプリント基板2へ出力する。次に送受信アンテナ5、6について説明する。携帯電話機には形状的な問題から主に $1/4\lambda$ の接地アンテナが用いられている。この接地アンテナのアンテナ長 l [m] や電圧・電流分布などを図6に示す。この場合アンテナ長 l が $1/4\lambda$ の時、アンテナ基部において電流最大、電圧最小となっているため、直列共振状態となり、アンテナのインピーダンスは抵抗分のみとなる。しかしながら実際の携帯電話機などで使われている搬送波は送信側254MHz（ $1/4\lambda$ は0.295m）、受信側380MHz（ $1/4\lambda$ は0.197m）であり、形状的に $1/4\lambda$ の長さのアンテナを実装することは難しいため、図7に示すように大

体アンテナ長が $1/4\lambda$ 以下となるアンテナが主であり、この場合アンテナインピーダンスは容量性になるので、図8の整合回路のようにインダクタンス a を直列に入れて補正する必要がある。

【0004】

【発明が解決しようとする課題】 従来の携帯電話用内蔵アンテナは以上のように構成されているので、インピーダンスマッチングをとるために整合回路を設けなければならず、形状の自由度がなく配設できるポイントが決まってしまう、量産性が悪いなどの問題点があった。

【0005】 この発明は上記のような問題点を解消するためになされたもので、小型の性能の良い携帯電話用内蔵アンテナを得ることを目的とする。

【0006】

【課題を解決するための手段】 この発明に係る携帯電話用内蔵アンテナはフレキシブルプリント基板上に、スパイラル状もしくはジグザグ状に形成し、薄形化するとともに小型化して携帯電話用に形成したものである。

【0007】

【作用】 この発明における携帯電話用内蔵アンテナはフレキシブルプリント基板上に、スパイラル状もしくはジグザグ状に形成したので、放射効率が良くなり薄形化とともに形状の自由度も増し、小型化することができる。

【0008】

【実施例】 実施例1. 以下、この発明の一実施例を図について説明する。図1において、1は携帯電話機（主にコードレス電話機）、2はプリント基板、3はプリント基板2に実装されている無線送受信機、5は送信アンテナ、6は受信アンテナ、7は無線送受信機3と送受信アンテナ5、6を接続するための中継基板である。図2は一例として送信アンテナ5の導体パターン図である。この導体パターンはパターン幅を $35\mu\text{m}$ の銅箔で作成し、その周囲を $25\mu\text{m}$ のポリイミドで包んで絶縁し、プリント基板の厚さを $100\mu\text{m}$ 以下とする。

【0009】 次に動作について説明する。電気的な信号の流れについては従来技術と同様であるため、ここでは説明を省略する。図2において、導体長は導体をスパイラル状に形成することにより目標とする携帯電話機（コードレス電話機）の搬送波（254MHz）の $1/4\lambda$ （0.295m）をとっている。また一番問題となる導体パターンを囲むフレキシブル材料の誘電正接（以下 $\epsilon \tan \delta$ という）といわれる損失に関するファクターであるが、絶縁材料であるポリイミドは高周波特性に優れていて殆ど問題にならず、導体と絶縁材料を接着する接着材の特性も一般に1GHz位までの高周波で使われているプリント基板であるガラスエポキシ基板と殆ど変わらない。かつ厚さが $100\mu\text{m}$ 以下と非常に薄くなるため、この部分での損失は少ないと考えられる。また携帯電話機などに使用されるアンテナの帯域幅はある程度広いことが望まれるが、この帯域幅を広くするためには一般的

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に線状アンテナの径を太くすることにより実現できるとされているが、従来の線状アンテナでは径もある程度限られていた。これに対しこの発明のアンテナでは導体をスパイラル状に形成することにより、図4に示すように等価的にアンテナの径を太くする働きがあり、前述のようにアンテナの帯域幅を広くとることができる。人体の影響を受けにくく、送受信電波の干渉を受けにくい様にするために、送受信アンテナを各々分離して、携帯電話機の先端部側面に配設している。

【0010】実施例2：アンテナの形状は実装される機器により自由であり、アンテナの広帯域化を図るためにアンテナ導体を図3に示すようにジグザグ状に形成することによってもアンテナの広帯域化を図ることができる。

【0011】

【発明の効果】以上のように、この発明によればアンテナをフレキシブルプリント基板上にスパイラル状もしくはジグザグ状に形成しているので、広帯域化が図れて放射効率の良い携帯電話用内蔵アンテナを得ることができる。

【図面の簡単な説明】

【図1】本発明のアンテナを内蔵した携帯電話機の構成図である。

【図2】本発明のアンテナの導体パターン図である。

【図3】本発明のアンテナの導体パターン図である。

【図4】本発明のアンテナの説明図である。

【図5】従来のアンテナを内蔵した携帯電話機の構成図である。

【図6】 $1/4$ λ長アンテナの電流・電圧分布である。

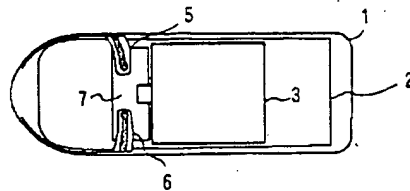
【図7】 $1/4$ λ以下長アンテナの電流・電圧分布である。

【図8】容量性アンテナの整合回路である。

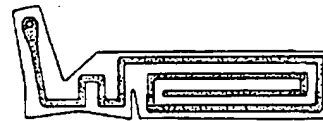
【符号の説明】

- 1 携帯電話機
- 2 プリント基板
- 3 無線送受信機
- 4 整合回路
- 5 送信アンテナ
- 6 受信アンテナ
- 7 中継基板

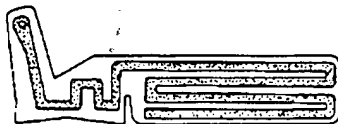
【図1】



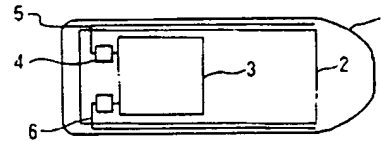
【図2】



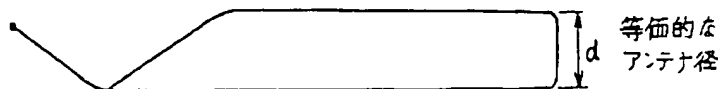
【図3】



【図5】



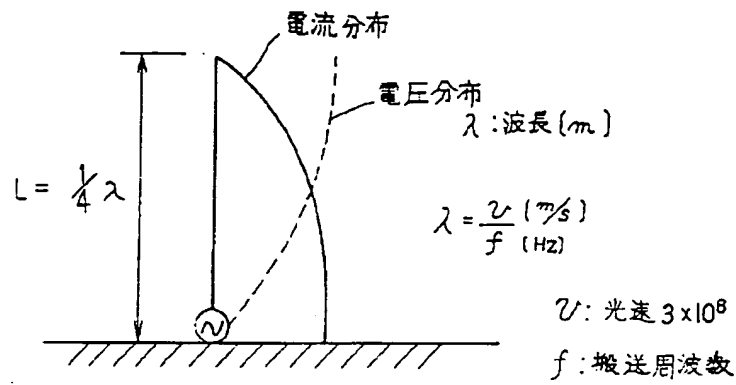
【図4】



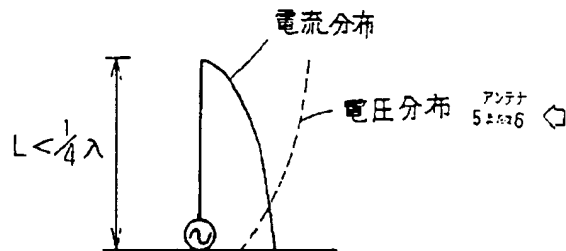
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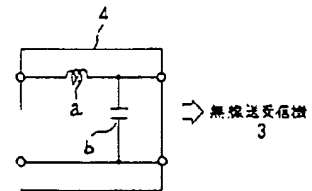
【図6】



【図7】



【図8】





Bescheid/Protokoll (Anlage)

Communication/Minutes (Annex)

Notification/Procès-verbal (Annexe)

Datum
Date 07.08.2001
Date

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Sheet 1
Feuille

Anmelde-Nr.:
Application No.: 99 928 950.7
Demande n°:

The examination is being carried out on the **following application documents**:

Text for the Contracting States:

AT BE CH LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE

Description, pages:

1-12 as received on 14.07.2000 with letter of
14.07.2000

Claims, No.:

1-10 as received on 14.07.2000 with letter of
14.07.2000

Drawings, sheets:

1/1 as originally filed

1. The following documents (D) are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1: Patent Abstracts of Japan JP5007109
& JP05007109A

D1T: An automated translation of the JP05007109A was found at the IPDL website of the Japanese Patent Office; a copy of the document is annexed to the communication

2. An international preliminary examination report has already been drawn up for the

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the built-in antenna for cellular phones.

[0002]

[Description of the Prior Art] drawing 4 -- the line of the conventional technique -- it is drawing showing the configuration of the portable telephone which arranged the antenna As for a matching circuit and 5, the radio transmitter-receiver with which a portable telephone and 2 are mounted in a printed circuit board, and 3 is mounted for 1 on a printed circuit board 2, and 4 are [a transmitting antenna and 6] receiving antennas. The output of the radio transmitter-receiver 3 is entered and transmitted to the transmitting antenna 5 via a matching circuit 4. Moreover, the signal which the receiving antenna 6 received goes into the radio transmitter-receiver 3 via a matching circuit 4. A length changes with frequencies of the subcarrier (henceforth a carrier) to use, and, generally the transceiver antennas 5 and 6 are set to $1/4\lambda$ (the $\lambda = v/f$ v: velocity of light, f: carrier frequency).

[0003] Next, an operation is explained. In drawing 4, a power supply section, a control section, the voice section, etc. are included in the printed circuit board 2. Within the radio transmitter-receiver 3, a subcarrier becomes irregular and the output from a printed circuit board 2 goes into a matching circuit 4. A matching circuit 4 is for taking impedance matching of the transmitting antenna 5 and the radio transmitter-receiver 3, and as generally shown in drawing 8, it is constituted by inductance a and capacitor b. The subcarrier added to the transmitting antenna 5 is emitted to space by the transmitting antenna 5. It is received by the receiving antenna 6 and the Hertzian wave transmitted from the base station side is efficiently sent to the radio transmitter-receiver 3 through a matching circuit 4. The radio transmitter-receiver 3 restores to the subcarrier which received, and outputs it to a printed circuit board 2. Next, the transceiver antennas 5 and 6 are explained. In the portable telephone, the grounding antenna of $1/4\lambda$ is mainly used from the geometrical problem. Antenna length l [m] of this grounding antenna, a voltage-current distribution, etc. are shown in drawing 6. In this case, since it is the current maximum and the voltage minimum in the antenna base when antenna length l is $1/4\lambda$, it will be in the series resonance status and the impedance of an antenna becomes only a resisted part. The subcarrier currently used by the actual portable telephone etc. 254MHz ($1/4\lambda = 0.295\text{m}$) of however, transmitting sides, Since it is difficult to be 380MHz ($1/4\lambda = 0.197\text{m}$) of receiving sides, and to mount the antenna of the length of $1/4\lambda$ geometrically, it is shown in drawing 7 -- as -- generally -- the antenna with which antenna length becomes below $1/4\lambda$ is main, and since an antenna impedance becomes capacitive in this case, it is necessary to put in inductance a in series and to rectify it like the matching circuit of drawing 8

[0004]

[Problem(s) to be Solved by the Invention] Since the conventional built-in antenna for cellular phones was constituted as mentioned above, in order to take impedance matching, the matching circuit had to be prepared, the point which there is no degree of freedom of a configuration and can be arranged was decided, and it had troubles, like mass-production nature is bad.

[0005] This invention was made in order to cancel the above troubles, and it aims at obtaining the built-in antenna for cellular phones with a small sufficient performance.

[0006]

[Means for Solving the Problem] On a flexible printed circuit board, it miniaturizes, while it forms the shape of spiral, and in the shape of zigzag and thin type is formed, and the built-in antenna for cellular phones concerning this invention is formed for cellular phones.

[0007]

[Function] Since it formed the shape of spiral, and in the shape of zigzag on the flexible printed circuit board, the built-in antenna for cellular phones in this invention becomes good, with thin type-ization, the degree of freedom of radiant efficiency of a configuration also increases, and it can miniaturize it.

[0008]

[Example] One example of this invention is explained about drawing below example 1. In drawing 1, the radio transmitter-receiver with which a portable telephone (mainly cordless telephone machine) and 2 are mounted in a printed circuit board, and 3 is mounted in the printed circuit board 2 for 1, and 5 are the relay substrates for a transmitting antenna and 6 connecting a receiving antenna and 7 connecting the transceiver antennas 5 and 6 with the radio transmitter-receiver 3. Drawing 2 is a conductor pattern view of the transmitting antenna 5 as an example. This conductor pattern makes pattern width of face from 35-micrometer copper foil, wraps the periphery in a 25-micrometer polyimide, insulates, and sets thickness of a printed circuit board to 100 micrometers or less.

[0009] Next, an operation is explained. Since it is the same as that of the conventional technique about flowing of an electric signal, an explanation is omitted here. drawing 2 -- setting -- a conductor -- merit has taken $1/4\lambda$ (0.295m) of the subcarrier (254MHz) of a target portable telephone (cordless telephone machine) by forming a conductor in the shape of spiral. Moreover, although it is a factor about the loss called dielectric dissipation factor (henceforth $\tan\delta$) of the flexible material surrounding the conductor pattern which poses a problem most, the polyimide which is an insulating material is excellent in the RF property, and hardly becomes a problem, but hardly changes with the glass epoxy-group plate with which the property of the binder which pastes up a conductor and an insulating material is generally also used by the RF to 1GHz grade and which is a printed circuit board. And since it is very thin thin with 100 micrometers or less, it is thought that there are few losses in this fraction. moreover -- although a thing large to some extent is desired, in order for the bandwidth of the antenna used for a portable telephone etc. to widen this bandwidth -- general -- a line -- although it is realizable by making the path of an antenna thick -- the conventional line -- with the antenna, the path was also restricted to some extent. On the other hand, with the antenna of this invention, by forming a conductor in the shape of spiral, as shown in drawing 4, there is work which makes the path of an antenna thick in equivalent, and the large bandwidth of an antenna can be taken as mentioned above. Since it is hard to be influenced of a human body and it is hard to receive an interference of a transceiver Hertzian wave, the antenna for transmission and reception is separated respectively, and it is arranging in the point side face of a portable telephone.

[0010] in order that the configuration of an example 2. antenna may be free and may attain wide band-ization of an antenna by the device

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mounted -- an antenna -- wide band-ization of an antenna can be attained also by forming a conductor in the shape of zigzag, as shown in drawing 3

[0011]

[Effect of the Invention] As mentioned above, since the antenna is formed the shape of spiral, and in the shape of zigzag on a flexible printed circuit board according to this invention, wide band-ization can be attained and the built-in antenna for cellular phones with sufficient radiant efficiency can be obtained.

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CLAIMS

[Claim(s)]

[Claim 1] (1) the flexible printed circuit board which arranged in the termination side from the nose of cam side in the configuration which had width of face near the portable telephone side face, and was built in the aforementioned portable telephone, and the antenna in which the pattern was made to form the shape of the shape of spiral, and zigzag distributed crosswise in accordance with the aforementioned substrate configuration on the aforementioned flexible printed circuit board -- the built-in antenna for cellular phones possessing the conductor
(2) an antenna -- a conductor -- the built-in antenna for cellular phones given in the 1st term of a claim which insulated the circumference by the polyimide

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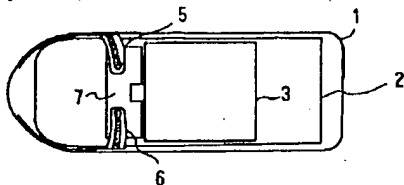
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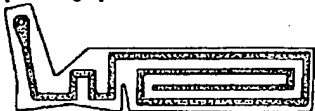
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DRAWINGS

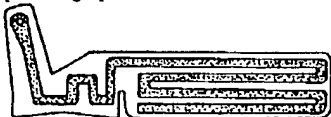
[Drawing 1]



[Drawing 2]



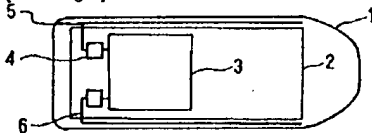
[Drawing 3]



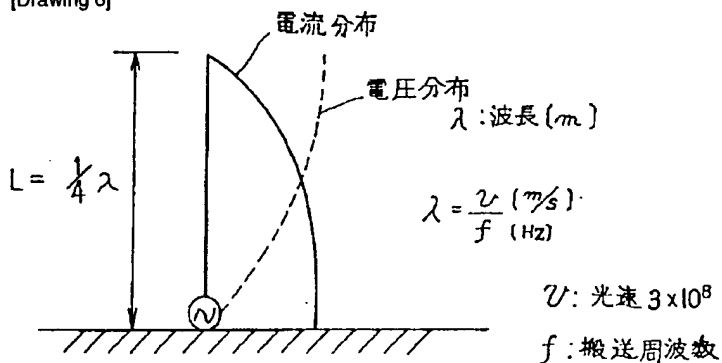
[Drawing 4]



[Drawing 5]

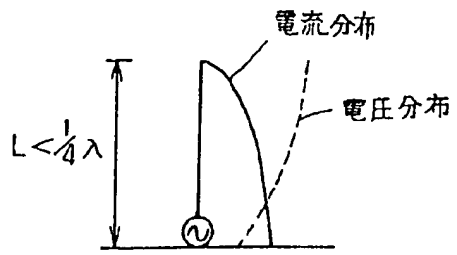


[Drawing 6]

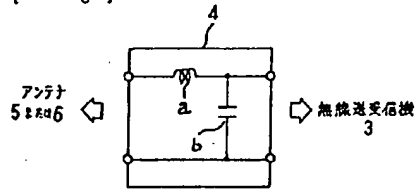


[Drawing 7]

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[Drawing 8]



[Translation done.]

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 99/00602

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H01Q1/24 H01Q1/38 H01Q1/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 017, no. 264 (E-1370), 24 May 1993 (1993-05-24) -& JP 05 007109 A (MITSUBISHI ELECTRIC CORP), 14 January 1993 (1993-01-14) abstract; figures 1-3,5-7	1,3,5,7, 9
Y	---	2,10
Y	PATENT ABSTRACTS OF JAPAN vol. 018, no. 188 (E-1532), 31 March 1994 (1994-03-31) -& JP 05 347507 A (JUNKOSHA CO LTD), 27 December 1993 (1993-12-27) abstract; figures 1-19 ---	2,10
	--- -/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

14 October 1999

Date of mailing of the international search report

21/10/1999

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